Mem. Natn. Sci. Mus., Tokyo, (23), December 1, 1990

Helminths Collected from Amphibians and Reptiles on Amami-oshima Island, Japan

By

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Introduction

Amami-oshima Island belongs to the Ryukyu Archipelago, and is located south of the Tokara Strait where lies the famous zoogeographical border called Watase's line between the Palearctic and Oriental Regions. Thus, the herpetofauna of Amami-oshima Island has affinities to that of more southern part of the Ryukyu Archipelago and Taiwan. Some endemic species and subspecies of amphibians and reptiles are also present. This paper reports helminths collected from amphibians and reptiles on this island in October, 1989 mainly. A discussion is made on the characteristics of the helminth fauna in comparison with those of the neighboring areas.

Materials and Methods

Amphibians and reptiles were captured by hand or with an insect net during the period from October 7 to 16, 1989, mainly. They were anesthesized to death with ether, and the viscera were examined under a dissecting microscope. The skeletal muscles were sliced, compressed between two glass plates, and examined under a dissecting microscope. Thin blood films were made and stained with Giemsa solution for detection of microfilariae. Some parasites were collected from hosts preserved in 5% formalin. Trematodes and cestodes were fixed in Carnoy's solution, relaxed in 45% acetic acid and then preserved in 70% ethanol. Nematodes were fixed with hot 70% ethanol. For microscopical examination, cestodes were stained with Meyer's hematoxylin, dehydrated, cleared and mounted with Canada balsam. Nematodes and some trematodes were cleared in a glycerin-alcohol solution and mounted with 50% glycerin aqueous solution. In description of new taxon, measurements are given for the holotype male and the allotype female, followed in parentheses by the range of paratypes.

Helminths Collected and Remarks

The hosts examined and helminths collected from them are listed in Table 1.

I. Trematoda

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Table 1 Helminths collected from amphibians and reptiles on Amami-oshima Island

Host (No. examined)	Helminths detected	Site in host	Prevalence (%) and intensity	NSMT No.
AMPHIBIA				
Cynops ensicauda (32)	*Mesocoelium brevicaecum*	Small intestine	19 (1−4)	Pl 3909
	Amphibiocapillaria tritonispunctati	Rectum	9 (1−4)	As 2058
	Rhabdias tokyoensis	Lung, body cavity	31 (1−12)	As 2059
	Cosmocercoides tridens	Rectum	3 (1)	As 2060
Rana limnocharis (12)	*Rhabdias* sp.	Rectum	8 (10)	As 2061
	Spiruridae sp. (larva)	Stomach wall	8 (1)	As 2062
Rana ishikawae (1)	*Mesocoelium brevicaecum*	Small intestine	− (15)	Pl 391(
	Meteterakis amamiensis	Rectum	− (5)	As 2063
// (2)*	*Mesocoelium brevicaecum*	Small intestine	50 (6−86)	Pl 3911
	Aplectana sp.	Rectum	100 (2−26)	As 2064
Rana (Babina) subaspera (10)	*Mesocoelium brevicaecum*	Small intestine	50 (1−9)	Pl 3912
	Cryptotropa kuretanii	Small intestine	10 (8)	Pl 3913
	Spirometra erinacei-europaei (plerocercoid)	Thigh	10 (1)	− − −
	Rhabdias sp.	Lung	80 (1−45)	As 2065
	Falcaustra sp.	Small intestine	60 (3−52)	As 2066
	Hexametra sp. (larva)	Stomach wall, mesentery	10 (6)	As 2067
	Icosiella sasai (microfilaria)	Blood	70 −	As 2068
Rana narina (6)	*Mesocoelium brevicaecum*	Small intestine	79 (1−50)	Pl 3914
	Aonchotheca sp.	Tongue	14 (1−3)	As 2069
	Rhabdias nipponica	Lung	79 (1−14)	As 2070
	Acuarioidea sp. (larva)	Thigh	21 (1−11)	As 2071
Rhacophorus viridis amamiensis (1)	*Polystoma* sp.	Urinary bladder	− (1)	Pl 3915
Buergeria japonica (1)	not detected			
REPTILIA				
Gehyra mutilata (6)	*Oochoristica chinensis*	Small intestine	17 (1)	Pl 3916
	Skrjabinodon sp.	Rectum	33 (1−3)	As 2072
	Spiruroidea sp. (larva)	Stomach wall	33 (4−9)	As 2073
Hemidactylus bowringii (2)	*Skrjabinodon* sp.	Rectum	50 (1)	As 2074
Eumeces marginatus oshimensis (4)	*Meteterakis amamiensis*	Rectum	20 (1−3)	As 2075
Ateuchosaurus pellopleurus (1)	*Centrorhynchus* sp. (larva)	Stomach wall	− (3)	− − −
// (1)*	*Neoentomelas asatoi*	Lung	− (3)	As 1911
	Meteterakis amamiensis	Rectum	− (13)	As 2076
Takydromus smaragdinus (4)	*Dispharynx* sp. (larva)	Stomach wall	25 (2)	− − −
Japalura polygonata polygonata (2)	not detected			
Trimeresurus okinavensis (1)	*Kalicephalus viperae chungkingensis*	Esophagus	− (7)	As 2077
	Hexametra quadricornis	Small intestine	− (5)	As 2078
// (1)**	*Kalicephalus viperae chungkingensis*	Esophagus	− (8)	As 2079
	Hexametra quadricornis	Small intestine	− (1)	As 2080
	Gnathostoma doloresi (larva)	Skeletal muscles	− (1)	As 2081
Dinodon semicarinatus (4)	*Kalicephalus posterovulvus*	Esophagus	25 (13)	As 2082
	Hexametra sp. (larva)	Mesentery	75 (1−17)	As 2083
	Gnathostoma doloresi (larva)	Skeletal muscles, intestinal wall	75 (2−534)	As 2084
	Centrorhynchus sp. (larva)	Mesentery	100 (2−>20)	As 2085
Entechinus semicarinatus (1)	*Rhabdias* sp.	Lung	− (2)	As 2086

*Collected in July, 1981. **Collected in December, 1988.

Only three species, *Mesocoelium brevicaecum* OCHI, 1930 (Digenea: Brachycoeliidae), *Cryptotropa kuretanii* OZAKI, 1929 (Digenea: Lecithodendriidae) and *Polystoma* sp. (Monogenea: Polystomatidae), were detected in the present survey. The former two species are parasitic in various amphibians and reptiles, and are widely distributed in adjacent areas (cf. HASEGAWA, 1984, 1985). UCHIDA & ITAGAKI (1975) and UCHIDA *et al.* (1977) also recorded *M. brevicaecum* from *C. ensicauda* and *Trimeresurus flavoviridis*. *Polystoma* sp. may be *P. rhacophori* YAMAGUTI, 1936. Besides these species, *Paradistomum habui* KAGEI, 1972, *Ophisthioglyphe* sp. and Urotrematidae sp. have been recorded from amphibians and reptiles on Amami-oshima Island (KAGEI, 1972; UCHIDA & UCHIDA, 1981).

II. Cestoda

Only one adult individual of *Oochoristica chinensis* JENSEN *et al.*, 1983 (Cyclophyllidea: Anoplocephalidae) was collected. This cestode was first described from *Japalura swinhonis* in Taiwan (JENSEN *et al.*, 1983). This is the first record of *O. chinensis* from Japan, and *Gehyra mutilata* is recorded as a new host. Plerocercoids of *Spirometra erinaceieuropaei* (RUDOLPHI, 1819) (Pseudophyllidea: Diphyllobothriidae) were found in the thigh of *Rana narina*. This form has been recorded from *T. flavoviridis* and *Rana* (*Babina*) *subaspera* on Amami-oshima Island (UCHIDA *et al.*, 1978).

III. Nematoda

Amphibiocapillaria tritonispunctati (DIESING, 1851) (Trichuroidea: Trichuridae) was collected from *Cynops ensicauda*. This species is parasitic in various urodels of Eurasia (MORAVEC, 1986). In the Ryukyu Archipelago, it has been recorded from *C. ensicauda* on Okinawa Island (HASEGAWA, 1989 b).

Aonchotheca sp. (Trichuroidea: Trichuridae) was found on the tongue of *Rana narina*. This species has been recorded from *R. narina* on Okinawa Island (HASEGAWA, 1989 b). *Rana narina* on Okinawa Island is also parasitized by another trichurid, *Paracapillaria* sp. (HASEGAWA, 1989 b), but this nematode was not collected from the frogs on Amami-oshima Island.

Several species of *Rhabdias* (Rhabditoidea: Rhabdiasidae) were collected (Table 1). *Rhabdias tokyoensis* WILKIE, 1930 and *R. nipponica* YAMAGUTI, 1935 have been also recorded from newts and ranid frogs, respectively, of various areas of Japan including Okinawa Island (WILKIE, 1930; YAMAGUTI, 1935; HASEGAWA, 1989 b). *Rhabdias nipponica* has been also reported from China and Viet Nam (KUNG & WU, 1945; WANG *et al.*, 1978; MORAVEC & SEY, 1985). *Rhabdias* spp. from *R.*(*B.*) *subaspera*, *Rana limnocharis* and *Entechinus semicarinatus* have not been identified at species level. A rhabdiasid, *Neoentomelas asatoi* HASEGAWA, 1989, has been described from *Ateuchosaurus pellopleurus* on Amami-oshima and Okinawa islands (HASEGAWA, 1989 c).

Kalicephalus viperae chungkingensis HSÜ, 1934 and *Kalicephalus posterovulvus* SCHAD, 1962 (Diaphanocephaloidea: Diaphanocephalidae) were collected from snakes. These two species have been also recorded from Okinawan snakes (HASEGAWA, 1982).

Skrjabinodon sp. (Oxyuroidea: Pharyngodonidae) from the geckonids resembles the species recorded from *Hemidactylus frenatus* on Okinawa Island (HASEGAWA, 1985) although its female is more stout.

Aplectana sp. (Cosmocercoidea: Cosmocercidae) was found from *Rana ishikawae* collected in 1981 (Table 1). Although the female tail is somewhat shorter, this species may be *A.*

macintoshii STEWART, 1914, which is distributed in both Old and New Worlds (cf. BAKER, 1980; BAKER & VAUCHER, 1986).

Only one male of *Cosmocercoides tridens* WILKIE, 1930 (Cosmocercoidea: Cosmocercidae) was collected from *C. ensicauda.* This nematode was first described from *Tylototriton andersoni* of "Riu Chu" (=Ryukyu) (WILKIE, 1930) and was recently redescribed from *T. andersoni* and *C. ensicauda* on Okinawa Island (HASEGAWA, 1989 a). HASEGAWA (1989 a) considered that *T. andersoni* is more suitable host than *C. ensicauda,* and the parasite was brought to the Ryukyu Archipelago with *T. andersoni* in the Miocene. Although in the present survey *T. andersoni* was not examined, it is suggested that *C. tridens* also parasitizes *T. andersoni* on Amami-oshima Island.

Many immature *Falcaustra* sp. (Cosmocercoidea: Kathlaniidae) were found from the posterior part of the small intesine of *R. (B.) subaspera.* This species was also collected from the same frog species in the survey in 1981 (HASEGAWA, 1989 b). Curiously, no mature adult has been observed.

Meteterakis amamiensis sp. n. (Heterakoidea: Heterakidae) was collected from *A. pellopleurus, Eumeces marginatus oshimensis* and *R. ishikawae* (Table 1). It is of interest that *R. ishikawae* on Amami-oshima Island harbors *M. amamiensis* instead of *M. ishikawanae* HASEGAWA, 1987, which has been described from the same frog species on Okinawa Island. HASEGAWA (1987, 1989 b) supposed that *M. ishikawanae* has strict host-specificity to *R. ishikawae* and was brought from continental China to the Ryukyu Archipelago by the ancestor of the frog. However, *M. ishikawanae* was recently collected from a land tortoise, *Geoemyda spengleri japonica,* on Okinawa Island (NAKACHI, personal communication). This fact demonstrates that *M. ishikawanae* has wider host range than supposed, and it is also possible that this nematode was introduced to Okinawa Island by some reptile. The absence of *M. ishikawanae* in *R. ishikawae* on Amami-oshima Island, where any land tortoise is not distributed, may support this possibility.

No nematode was detected from *Japalura polygonata polygonata,* although UCHIDA *et al.* (1979) recorded *Strongyluris calotis* BAYLIS & DAUBNEY, 1923 (as *Ascaridia japalurae* YAMAGUTI, 1935) from this lizard. This nematode is a common parasite of *J. polygonata* of the Ryukyu Archipelago (cf. HASEGAWA, 1985).

Adult *Hexametra quadricornis* (WEDL, 1861) (Ascaridoidea: Ascarididae) was collected from *Trimeresurus okinavensis.* This ascarid is widely distributed in the Old World and parasitic in various snakes (SPRENT, 1978). In Okinawa, this nematode has been reported from three species of snakes including *T. okinavensis* (HASEGAWA, 1985). On Amami-oshima Island, *Ophidascaris natricis* YAMAGUTI, 1935 has been recorded from *T. flavoviridis* (HORI & KANEKO, 1969; ISHII, 1973). However, the validity of *O. natricis* is doubtful, and probably it is a junior synonym of *H. quadricornis* (cf. SPRENT, 1978).

Larval ascarid, morphologically indistinguishable from that of *H. quadricornis,* was collected from *R. (B.) subaspera* and *Dinodon semicarinatus* (Table 1). *Hexametra quadricornis* usually utilizes small mammals as intermediate hosts (cf. PETTER, 1968). However, SPRENT (1978) reported that immature adult *Hexamtera* from *J. swinhonis* and *Takydromus septentrionalis* of Taiwan was indistinguishable from *H. quadricornis.* HASEGAWA (1985) also collected adult male ascarids resembling *H. quadricornis* from subcutaneous cysts in *Gekko*

hokouensis (recorded as *G. japonicus*). These findings suggest that this *Hexametra* does not always require a mammalian intermediate host for development.

Larvae of *Gnathostoma doloresi* TUBANGUI, 1925 (Gnathostomatoidea: Gnathostomatidae) were collected from *R. (B.) subaspera* and *D. semicarinatus*. On Amami-oshima Island, adults of this parasite have been recorded from the wild boar, *Sus scrofa riukiuanus* (UCHIDA *et al.*, 1984), and larvae from *T. flavoviridis, T. okinavensis, D. semicarinatus* and *R. (B.) subaspera* (TADA *et al.*, 1969; TOSHIOKA, 1970; MAKO & AKAHANE, 1985; HASEGAWA *et al.*, 1982).

Microfilariae of *Icosiella sasai* HAYASHI, 1960 (Filarioidea: Onchocercidae: Onchocercinae) were detected in blood samples of *R. (B.) subaspera*, although adult worm was not detected. This species has been reported only from *R. (B.) subaspera* on Amami-oshima Island (HAYASHI, 1960; HASEGAWA, 1989 b).

IV. Acanthocephala

Adult acanthocephalan was not detected in the present survey. Larval forms of *Centrorhynchus* spp. (Centrorhynchidae) were collected. The final hosts are considered to be some carnivorous birds.

Description of New Taxon

Meteterakis amamiensis sp. n.
(Heterakoidea: Heterakidae: Meteterakinae)
(Fig. 1)

General: Small worm with tapered extremities. Cuticle striated transversely. Lateral alae relatively wide, commencing from level anterior to nerve ring and ending at precloacal region in male and near posterior end in female. Cephalic end with 3 lips separated from each other by grooves of which posterior margin extending to anterior 1/4 of pharynx. Dorsal lip with 2 double cephalic papillae and 2 minute apical papillae; subventral lips each with a subventral double papilla, a sublateral single papilla, 2 minute apical papillae and an amphidial pore. Esophagus with cylindrical and bulbous portions. Nerve ring anterior to middle of cylindrical portion of esophagus, and excretory pore at level of midesophagus. Excretory vesicle large.

Male (holotype and 9 paratypes): Length 3.49 (2.00–5.25) mm, and maximum width 125 (93–207) μm. Posterior part bent ventrally. Pharynx 35 (34–50) μm long; cylindrical portion of esophagus 370 (318–435) μm long and 33 (30–39) μm wide; bulbous portion 115 (108–176) μm long by 93 (75–113) μm wide. Nerve ring and excretory pore 195 (173–257) μm and 250 (230–417) μm, respectively, from cephalic extremity. Spicules subequal, usually left one longer, chitinized strongly, heavily tessellated, with narrow alae, curved ventrally, with wide funnel shaped proximal end and pointed distal end. Right spicule 444 (229–625) μm long, left spicule 492 (227–640) μm long. Caudal alae supported by 3 pairs of large papillae: 2 pairs at level of preanal sucker and 1 pair immediate posterior to anus. Preanal sucker, 35 (25–42) μm in diameter, 35 (22–44) μm apart from anus. About 5 irregular pairs of minute sessile papillae present preanally and 2 pairs of them on anterior anal lip. Postanal minute papillae about 5 pairs. Tail conical, bent ventrally, with pointed tip, 183 (133–240) μm long.

Female (allotype and 8 paratypes): Length 4.37 (3.00–5.80) mm, maximum width 150 (113–226) μm. Pharynx 45 (38–50) μm long; cylindrical portion of esophagus 413 (363–466) μm long and 35 (30–41) μm wide; bulbous portion 143 (110–164) μm long by 113 (90–120) μm wide.

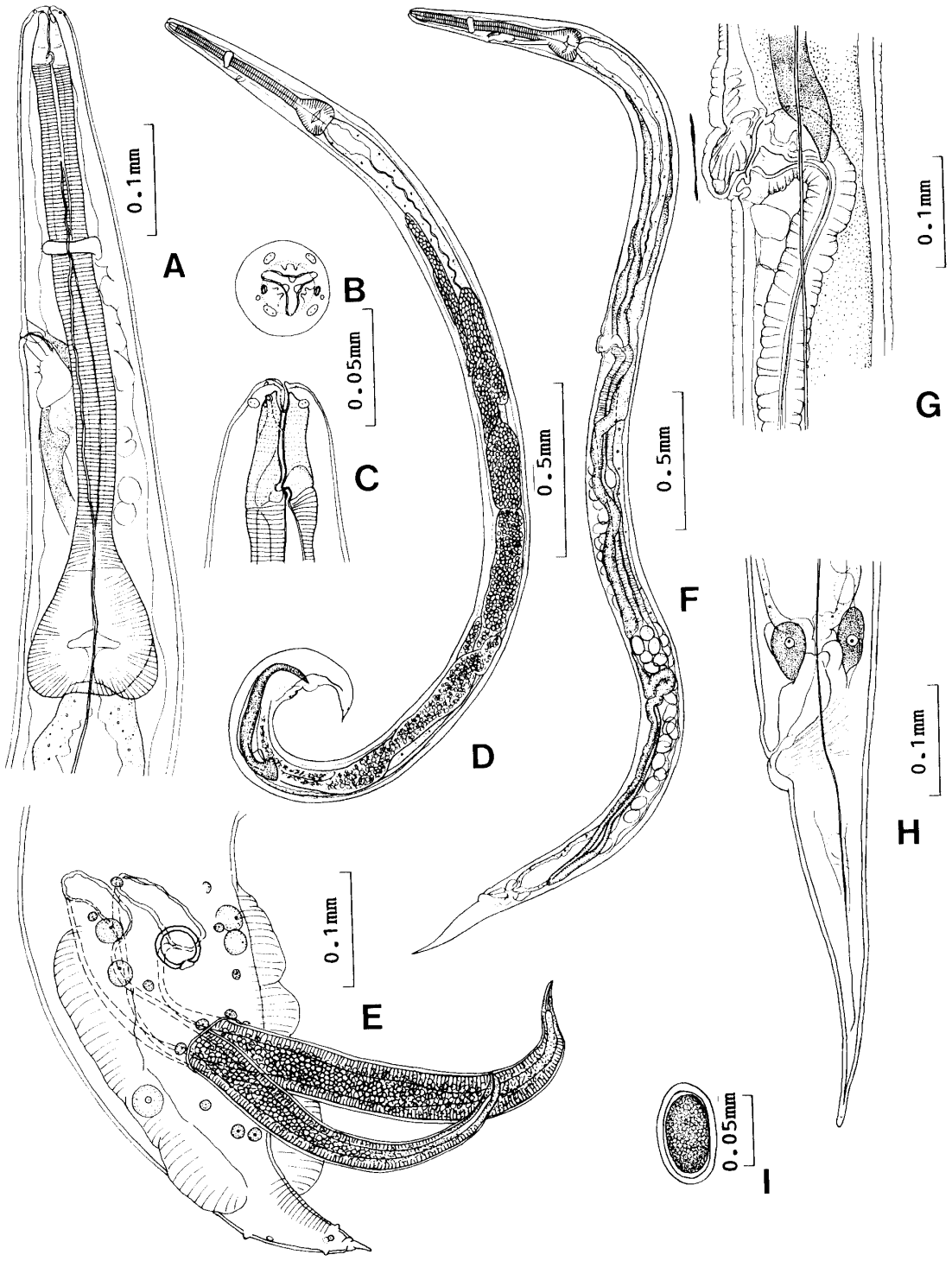

Fig. 1. *Meteterakis amamiensis* sp. n. A. Anterior part of paratype, left lateral view. B. Cephalic extremity of paratype, apical view. C. Cephalic extremity of paratype, left lateral view. D. Holotype male, left lateral view. E. Caudal extremity of paratype male, subventral view. F. Allotype female, left lateral view. G. Vulval part of allotype, left lateral view. H. Caudal extremity of paratype female, left lateral view. I. Egg.

Nerve ring, excretory pore and vulva 228 (188-244) μm, 294 (255-359) μm and 1.80 (1.27-2.33) mm, respectively, from cephalic extremity. Prevulval flap well developed in fully gravid individuals. Vagina muscular, running posteriorly. Tail long conical, 330 (220-398) μm long. Eggs elliptical, thick-shelled, containing morula-stage embryos and 63-70$\times$38-44 μm.

Host: *Ateuchosaurus pellopleurus, Eumeces marginatus oshimensis* and *Rana ishikawae.*

Habitat: Rectum.

Locality: Setouchi-cho and Mt. Yuan, Amami-oshima Island, Japan.

Remarks: *Meteterakis amamiensis* resembles closely *M. japonica* (WILKIE, 1930), a common parasite of *Bufo* spp. of Asia (cf. HASEGAWA, 1984, 1989b). However, it differs from *M. japonica* in having a slimmer body, a shorter esophagus, shorter distance from cephalic extremity to nerve ring and excretory pore, and a well developed prevulval flap, and dissimilar spicules (cf. WILKIE, 1930; YAMAGUTI, 1935; INGLIS, 1958). *Meteterakis amamiensis* also differs from *M. paucipapillosa* WANG, 1980, which was described from *Eumeces elegans* of Fujian, China, in having a slimmer body and a much shorter esophagus in both sexes, and more caudal papillae and thicker spicules in male (WANG, 1980). *Meteterakis amamiensis* is easily distinguished from *M. ishikawanae* HASEGAWA, 1987 in that the proximal ends of the spicules are markedly widened and the grooves between the lips are less extended posteriorly.

Discussion

The helminth fauna of amphibians and reptiles of Amami-oshima Island resembles closely that of Okinawa Island. For example, all of the helminth parasites collected from *C. ensicauda, R. narina, T. okinavensis* and *D. semicarinatus* in the present survey are also found in the respective hosts on Okinawa Island (cf. HASEGAWA, 1984, 1985, 1989 b). This seems reasonable because considerable members of the herpetofauna are shared with both islands. The faunistic similarity is apparently attributed to the geological process of island formation of the Ryukyu Archipelago. It is considered that in the early Pleistocene the Ryukyu Archipelago was an arch of land interrupted at the Tokara Strait, which prevented migration of terrestrial vertebrates. Amami and Okinawa groups of islands were then isolated from the rest of the archipelago in the middle Pleistocene (KIZAKI & OSHIRO, 1977). Most of the aboriginal herpetofauna have derived from the ancestors which were left on the islands by the isolation.

On the other hand, some characteristic species are also present on Amami-oshima Island. *Icosiella sasai* and *Falcaustra* sp. have been known only from *R. (B.) subaspera,* which is distributed only on Amami-oshima Island, and *M. amamiensis* has not been recorded from other localities. *Falcaustra* sp. is supposed to have close coevolutionary relationship with *R. (B.) subaspera.*

As far as the present survey concerns, the helminth fauna of amphibians and reptiles of Amami-oshima Island is somewhat poorer than that of Okinawa Island. From *R. narina,* for example, adult forms of five nematode species were found on Okinawa Island (HASEGAWA, 1989 b), while on Amami Island only two were found although the frogs had much larger body than the individuals on Okinawa Island. Moreover, no sexually matured nematode was collected from the alimentary canal of *R. (B.) subaspera,* which is a large frog reaching 120 mm in snout-vent length. It is quite curious that *Cosmocerca japonica* YAMAGUTI, 1938, one of the commonest nematodes of various frogs on Okinawa Island and the mainland of Japan (cf.

HASEGAWA, 1989b), was not found from any amphibian in the present survey.

The cause of this scantness of helminth fauna is difficult to be explained. Nevertheless, several possibilities may be pointed out. First, Amami-oshima Island is smaller than Okinawa Island. It has been well documented that the size of island is a limiting factor for the number of species inhabiting (cf. WILLIAMSON, 1981). Second, Amami-oshima Island is the northernmost one of the Oriental Region, and thus the climate is much colder than in the other southern islands. It may be possible that the climate has eliminated some parasites which required warmer condition for maintenance of their life cycles. And third, the recent forest development might simplify the environment eliminating the helminths which require complex environment for growth and/or transmission. It is of interest that the helminth fauna of *R. narina* on Amami-oshima is almost comparable with that of Okuma, Okinawa Island, where a forest clearing is in progress. Probably, more helminth species are still existing in some limited localities on Amami-oshima Island. Further extensive studies are required to elucidate the whole helminth fauna of amphibians and reptiles on Amami-oshima Island.

Acknowledgments

Thanks are tendered to Dr. S. HATTORI, Mr. Y. NOBORU and Mr. H. ASAKI, Amami Research Center, Institute of Medical Science, Tokyo University, Mr. N. IWATSUKI and Mr. R. ASATO for their kindness in collecting materials. Thanks are also due to Dr. M. MACHIDA, National Science Museum, for his kindness in giving the opportunity for investigation.

摘　　要

国立科学博物館の「奄美諸島・トカラ列島の自然史科学的総合研究」の一環として，平成元年10月に行った奄美大島産両生・爬虫類の寄生蠕虫の調査結果を，それまでに行った予備的調査の結果と合せて報告した．両生類7種，爬虫類9種計91個体を調査し，約30種の寄生蠕虫を得，線虫1新種を記載した．奄美大島の両生・爬虫類の蠕虫相は基本的に沖縄島のそれに近似していたが，本調査に関する限りより貧弱な印象を受けた．シリケンイモリ，ハナサキガエル，ヒメハブの寄生蠕虫は全て沖縄本島の当該宿主に見られるもので，しかもハナサキガエルは沖縄産より大型であるにもかかわらず寄生虫種は少なかった．また大型種オットンガエルでは消化管寄生線虫は未熟な1種が見られたにすぎない．さらに周辺地域の両生類に普通の寄生線虫である *Cosmocerca japonica* がいずれの両生類にも検出されなかった．一方，周辺地域でこれまで検出されていない蠕虫種も見られた．*Icosiella sasai* および成熟個体は得られなかったが *Falcaustra* sp. は奄美大島固有種オットンガエルにのみ検出された．新種 *Meteterakis amamiensis* はヘリグロヒメトカゲ，オオシマトカゲ，イシカワガエルから得られた．本種は交接刺基部が大きく開いていることでアジアのヒキガエル類等に広く寄生する *M. japonica* や福建省のトカゲ寄生の *M. paucipapillosa* に類似するが，食道長，雄尾部の乳頭配列や雌陰門部の形態，交接刺の形態が異なること等で区別される．沖縄島のイシカワガエルには別種 *M. ishikawanae* が寄生しているが，これとは交接刺の形態が異なり容易に区別される．沖縄島と奄美大島でイシカワガエルに寄生する同一属線虫の種が異なることはこれら線虫の由来を考える上で興味深い．奄美大島の両生・爬虫類の寄生蠕虫相が貧弱な理由は不明であるが，この島が沖縄島より小さく，それが制限要因となったこと，琉球列島内では東洋区の北端にあたり，寒冷な気候の影響をより受け易かったこと，更に近年の森林開発が環境を単純化し，発育や伝播に複雑な環境を要する蠕虫種を圧迫したこと等が考えられる．一方まだ多くの寄生蠕虫が局地的に存在している可能性もあり，更に調査が必要である．

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